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FINAL REPORT

May 1988

EVT 52-87

ENGINEERING TEST OF PRO-FORM
MATERIAL HANDLING DIVISION OF
L.T. HAMPLE CORPORATION
4,000-POUND STEEL REINFORCED
PLASTIC PALLET

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ELECTE
APR 24 1989
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Prepared for:

U.S. Army Armament Research,
Development and Engineering Center
ATTN: SMCAR-ESK
Rock Island, IL 61299-7300

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EVALUATION DIVISION
SAVANNA, ILLINOIS 61074-9639

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<p>The U.S. Army Defense Ammunition Center and School (USADACS), Evaluation Division, has been tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), SMCAR-ESK, Rock Island, IL 61299-7300, to subject a plastic pallet submitted by PRO-FORM, Material Handling Division of L. T. Hample Corporation, to MIL-STD-1660 test requirements to determine if it is acceptable for use in the transportation of ammunition. The sample pallet was loaded to 4,000 pounds and subjected to the first two steps in the MIL-STD-1660 testing sequence. The plastic pallet collapsed approximately 90 minutes into the transportation simulation portion of the test and was determined to be not suitable for the transportation of ammunition.</p> <p><i>regarding pallets</i></p>					
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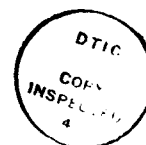
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL
Evaluation Division
Savanna, IL 61074-9639

REPORT NO. EVT 52-87

TABLE OF CONTENTS

PART		PAGE NO.
1.	INTRODUCTION	1-1
	A. Background	1-1
	B. Authority.	1-1
	C. Objective.	1-1
2.	ATTENDEES.	2-1
3.	TEST PROCEDURES.	3-1
4.	TEST EQUIPMENT	4-1
5.	TEST RESULTS	5-1
6.	CONCLUSIONS	6-1
7.	PHOTOGRAPHS.	7-1
8.	TEST DRAWINGS.	8-1

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PART 1

INTRODUCTION

A. BACKGROUND. The U.S. Army Armament Research, Development and Engineering Center (ARDEC), SMCAR-ESK, Rock Island, IL 61299-7300 has tasked The U.S. Army Defense Ammunition Center and School (USADACS) to test the PRO-FORM Material Handling Division of L.T. Hample Corporation steel-reinforced plastic pallet to MIL-STD-1660 requirements. It has also been requested that any deficiencies in the pallet design be identified, other than the physical size of the pallet. The pallet supplied was capable of sustaining a load of 5,000 pounds; however, a 4,300-pound test load was used to simulate a maximum realistic ammunition pallet load.

B. AUTHORITY. This study was conducted in accordance with mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM) as requested by SMCAR-ESK.

C. OBJECTIVE. The objective of this report is to document MIL-STD-1660 design criteria for ammunition unit loads as applied to the steel reinforced plastic pallet supplied by PRO-FORM Material Handling Division of L.T. Hample Corporation, Germantown, WI.

PART 2

ATTENDEES

Mr. A. C. McIntosh
Test Engineer

U.S. Army Defense Ammunition Center and School
ATTN: SMCAC-DEV
Savanna, IL 61074-9639
AV 585-8989

Mr. David Valant
Electronics Technician

U.S. Army Defense Ammunition Center and School
ATTN: SMCAC-DEV
Savanna, IL 61074-9639
AV 585-8988

PART 3

TEST PROCEDURES

The test procedures outlined in this section are extracted from MIL-STD-1660, Design Criteria for Ammunition Unit Loads, 8 April 1977. This standard identifies nine steps that a unitized load must undergo if it is considered to be acceptable. The tests conducted on the plastic pallet are synopsized below:

1. STACKING TESTS. The unit load shall be loaded to simulate a stack of identical unit loads stacked 16 feet high, for a period of one hour. This stacking load is simulated by subjecting the unit load to a compression of weight equal to an equivalent 16-foot stacking height. The compression load is calculated in the following manner. The unit load weight is divided by the unit load height in inches and multiplied by 192. The resulting number is the equivalent compressive force of a 16 foot high load.
2. REPETITIVE SHOCK TEST. The repetitive shock test shall be conducted in accordance with Method 5019, Federal Standard 101. The test procedure is as follows: The test specimen shall be placed on, but not fastened to, the platform. With the specimen in one position, vibrate the platform at 1/2 inch amplitude (1 inch double amplitude) starting at a frequency of about 3 cycles per second. Steadily increase the frequency until the package leaves the platform. The resonant frequency is achieved when a 1/16-inch-thick feeler may be momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle or a platform acceleration achieves one plus or minus zero point one G. Midway into the testing period the specimen shall be rotated 90 degrees and the test continued for the duration. If failure occurs, the total time of vibration shall be two hours if the specimen is tested in one position; and if tested in more than one position, the total time shall be three hours.

PART 4

TEST EQUIPMENT

1. TEST SPECIMEN.

- a. Drawing Number: 19-48-4116/15C
- b. Width: 44 inches
- c. Length: 48 inches
- d. Height: 49-3/4 inches
- e. Weight: 4,300 pounds

2. COMPRESSION TESTER.

- a. Manufacturer: Ormond Scientific
- b. Platform: 60 inches by 60 inches
- c. Compression Limit: 50,000 pounds
- d. Tension Limit: 50,000 pounds

3. TRANSPORTATION SIMULATOR.

- a. Manufacturer: Gaynes Laboratory
- b. Capacity: 6,000 pound pallet
- c. 1/2-inch Amplitude
- d. Speed: 50 to 3000 cpm
- e. Platform: 5 foot by 8 foot

PART 5

TEST RESULTS

1. STACKING TEST.

Pallet Weight - 4,300 pounds

Pallet Height - 49.75 inches

Test Load - 16,600 pounds

The subject pallet was loaded to 17,000 pounds compression for a period of one hour. At the end of that period of time the compression load decreased to approximately 16,500 pounds. When the test specimen was removed from the compression tester no measurable deformation was realized.

2. REPETITIVE SHOCK TEST. The subject pallet failed the transportation test in a 90-minute period. The transportation simulator was operated at 200 rpm for the duration of the test. Failure occurred in collapse of the center posts on the pallet from fatigue.

PART 6

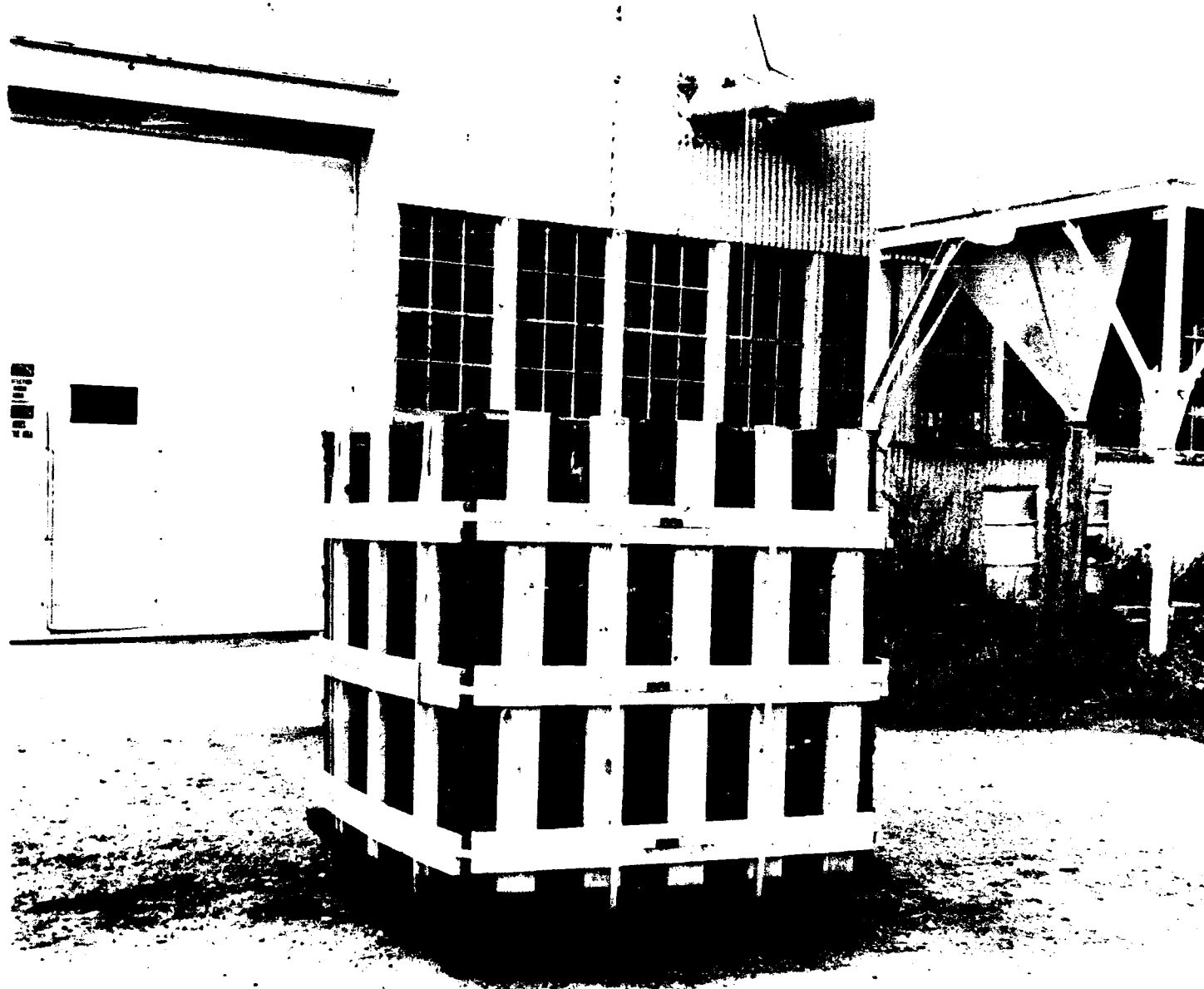
CONCLUSIONS

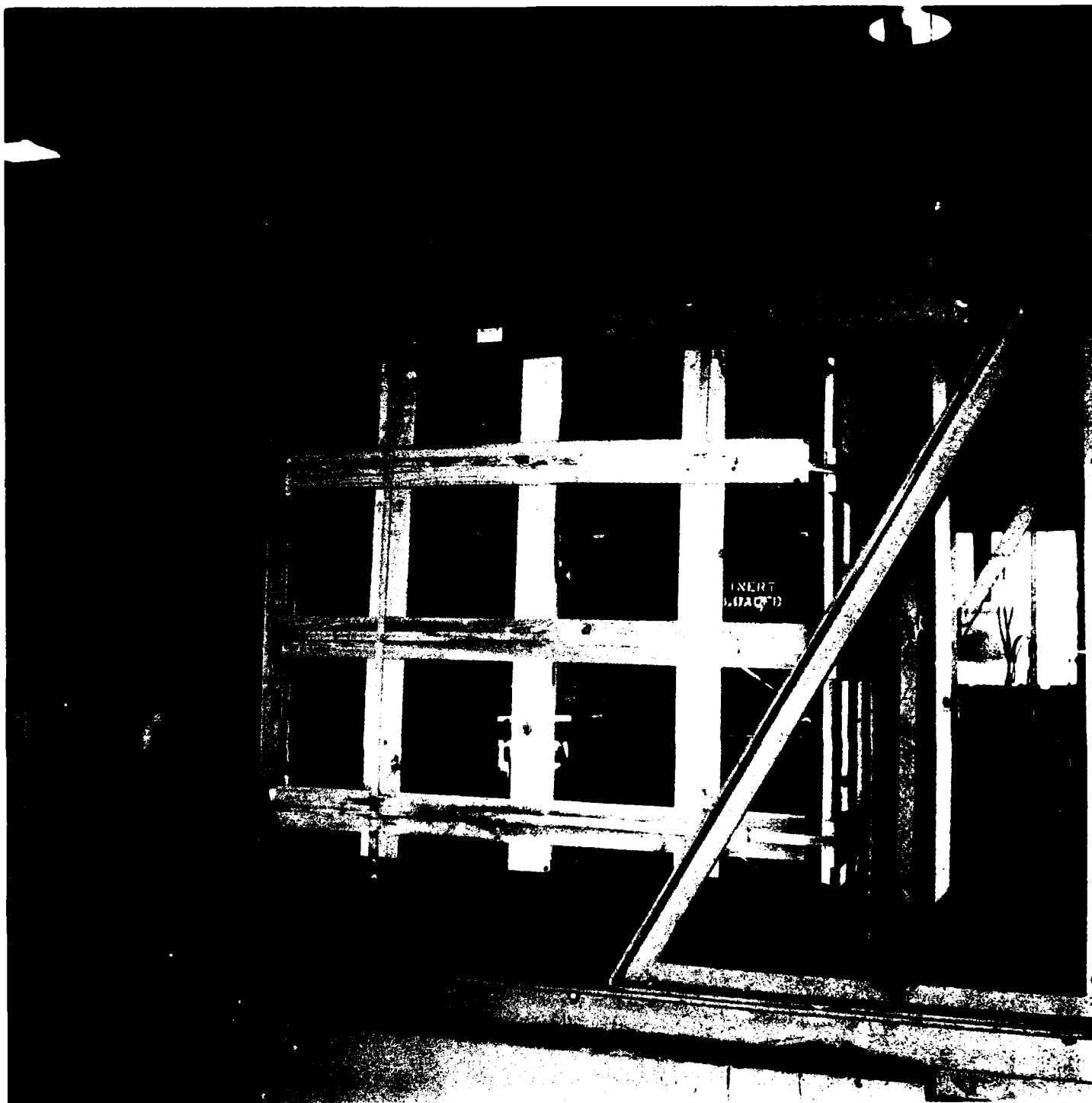
1. CONCLUSIONS. The PRO-FORM Material Handling Corporation Division of L.T. Hamble Corporation steel reinforced plastic pallet did not satisfy the design criteria for ammunition unit loads (MIL-STD-1660). The failure occurred during the transportation simulation test. The failure was a collapse of the outside center posts. The center posts cracked from the deck and at the base. This pallet, as designed, is not acceptable for the transportation of ammunition.

PART 7
PHOTOGRAPHS

DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
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Photo No. 1. This photo shows the PRO-FORM Material Handling Division of L.T. Hample Corporation steel reinforced plastic pallet loaded to a weight of 4,300 pounds prior to testing.





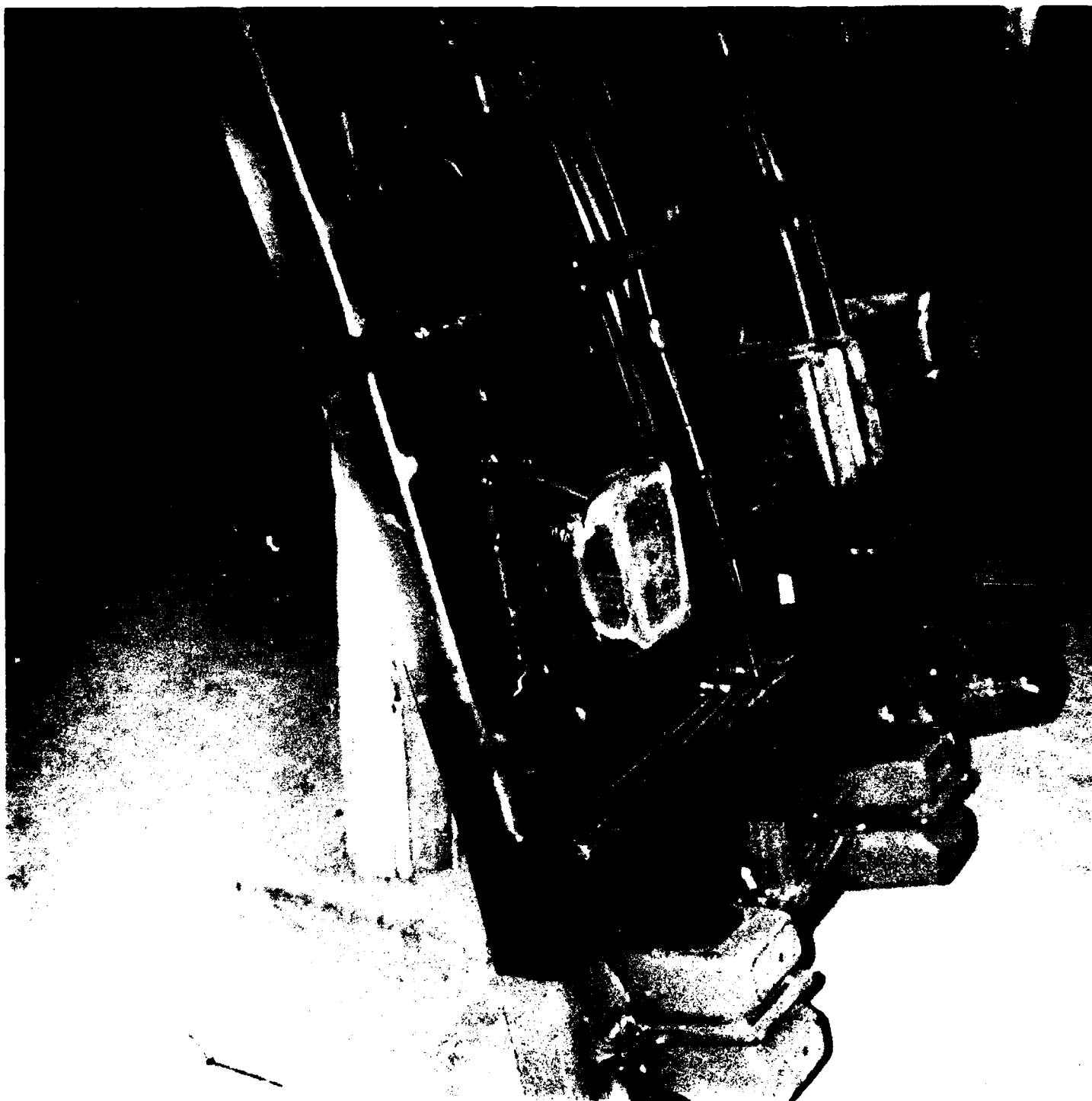
DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
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Photo No. 2. This photo shows the PRO-FORM Material Handling Division of L.T. Hamble Corporation steel reinforced plastic pallet loaded in the transportation simulator prior to testing.



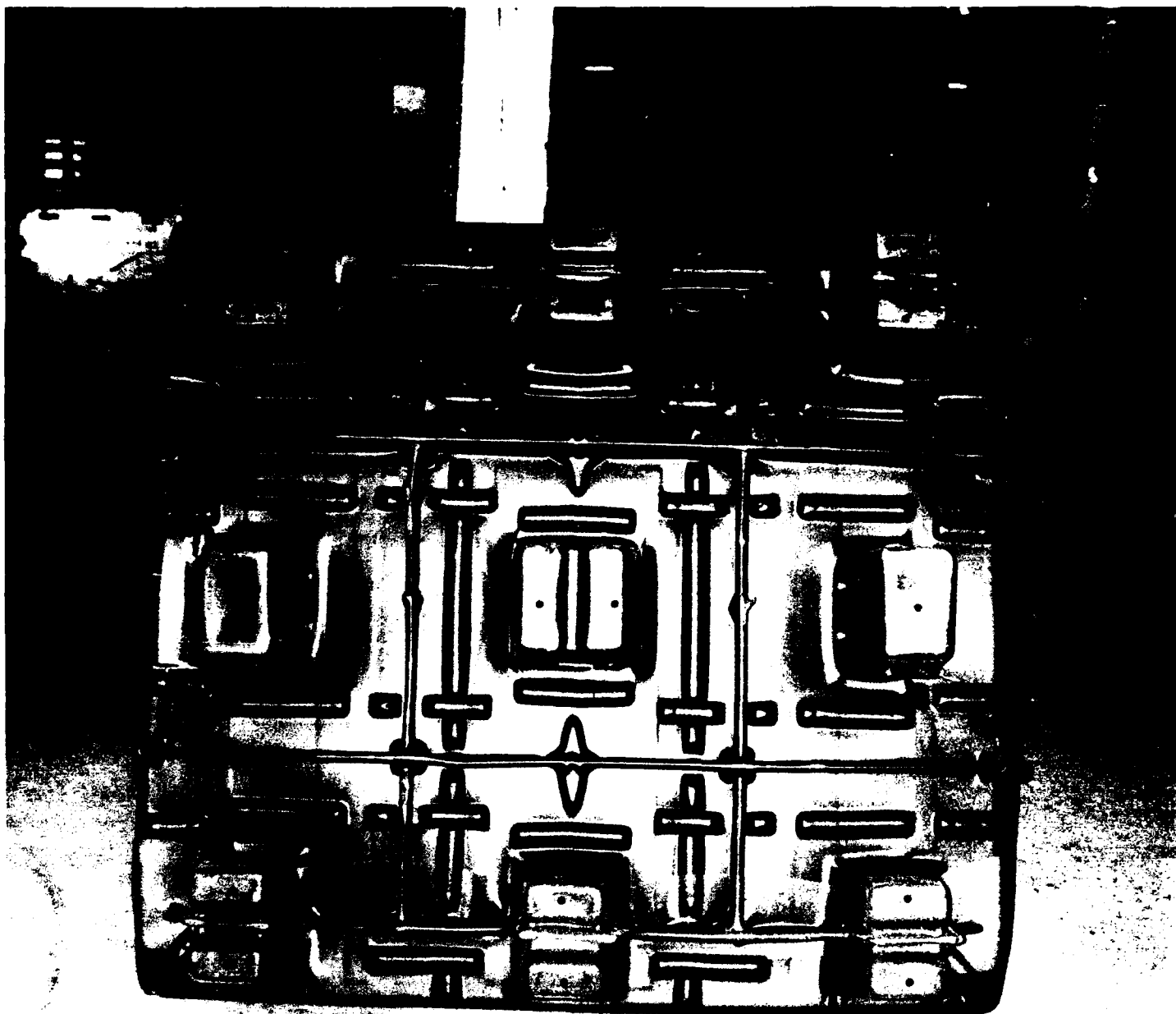
DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 3. This photo shows the PRO-FORM Material Handling Division of L.T. Hamble Corporation steel reinforced plastic pallet with the collapsed center posts after a 90-minute period in the transportation simulator. Note that the pallet deck has also collapsed from the weight of the load.



DEFENSE AMMUNITION CENTER AND SCHOOL- SAVANNA, IL

Photo No. 4. This photo shows the PRO-FORM Material Handling Division of L.T. Hamble Corporation steel reinforced plastic pallet after it was unloaded. Note the cracking of the center pillar at the deck and of the upper and lower pillars in the foreground. Also note that the pillar has deformed from heat generated during the transportation simulation test.



	DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
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Photo No. 5. This photo shows a bottom view of the PRO-FORM Material Handling Division of L.T. Hamble Corporation steel reinforced plastic pallet. Note the cracking around the joints where the posts connect to the pallet deck.

PART 8
TEST DRAWINGS

APPENDIX 15C

UNITIZATION PROCEDURES FOR BOXED AMMUNITION AND COMPONENTS ON 4-WAY ENTRY PALLETS

CARTRIDGE, 20MM, PACKED VARIOUS QUANTITIES PER M548 METAL BOX, UNITIZED 24 BOXES PER 40" X 48" PALLET; APPROX BOX SIZE 18 $\frac{19}{32}$ " L X 8 $\frac{19}{64}$ " W X 14 $\frac{19}{32}$ " H

① HAZARD CLASSIFICATION DATA CONTAINED IN THE CHART AT LEFT IS FOR GUIDANCE AND INFORMATIONAL PURPOSES ONLY. VERIFICATION OF THE SPECIFIED DATA SHOULD BE MADE BY CONSULTING THE MOST RECENT JOINT HAZARD CLASSIFICATION SYSTEM LISTING OR OTHER APPROVED LISTING(S).

PALLET UNIT DATA						
ITEMS INCLUDED		HAZARD CLASSIFICATION ①				WEIGHT (LBS)
NSN	DODIC	DOT CLASS	CG CLASS	QD CLASS	COMP GROUP	
1305-						
00-785-2829	A651	C	I	1.4	C	3,981
00-522-3700	A651	C	I	1.4	C	3,981
00-935-6171	A659	A	IV	(04) 1.2	E	3,981
00-143-6919	A769	A	IV	(04) 1.2	E	3,189
00-143-6918	A770	A	IV	(04) 1.2	E	3,189
00-926-9278	A791	A	IV	(04) 1.2	E	3,981
00-143-7050	A813	A	IV	(04) 1.2	G	3,189
00-143-7049	A814	A	IV	(04) 1.2	G	3,189
00-180-9270	A833	A	IV	(04) 1.2	E	3,189
00-180-9271	A834	A	IV	(04) 1.2	E	3,189
00-143-7176	A835	A	IV	(04) 1.2	E	3,189
00-143-7177	A836	A	IV	(04) 1.2	E	3,189
00-143-7167	A846	A	IV	(04) 1.2	G	3,189
00-112-0491	A865	A	IV	(04) 1.2	E	3,189
00-112-0494	A865	A	IV	(04) 1.2	E	3,189
00-112-0492	A866	A	IV	(04) 1.2	E	3,189
00-112-0493	A866	A	IV	(04) 1.2	E	3,189
00-935-9104	A890	A	IV	(04) 1.2	E	3,981
00-935-2019	A892	C	I	1.4	C	3,981
00-799-8669	A924	---	---	---	---	3,981
01-116-3923	A924	---	---	---	---	3,501
01-116-3931	A890	A	IV	(04) 1.2	E	3,981
01-116-3930	A892	C	I	1.4	C	3,981
00-752-8114	A891	C	I	1.4	C	3,525
01-116-4560	A891	C	I	1.4	C	3,525
01-118-9928	A890	A	IV	(04) 1.2	E	3,981
01-118-9930	A651	C	I	1.4	C	3,981
01-118-9929	A659	A	IV	(04) 1.2	E	3,981

THIS APPENDIX SUPERSEDES THE TWO-LAYER UNITIZATION PROCEDURES OF INTERIM DRAWING 19-48-4141-20PA1003, DATED FEBRUARY 1977.

DO NOT SCALE

REVISIONS

REVISION NO. 1, DATED NOVEMBER 1981, CONSISTS OF:

1. ADDING NATIONAL STOCK NUMBER TO THE "PALLET UNIT DATA" CHART.

2. REDESIGNING "FILLER ASSEMBLY".

REVISION NO. 2, DATED NOVEMBER 1982, CONSISTS OF:

ADDING NOTE "J" TO GENERAL NOTES SECTION ON PAGE 2.

REVISION NO. 3, DATED DECEMBER 1983, CONSISTS OF:

1. CHANGING BOX DIMENSIONS.

NOTICE: THIS APPENDIX CANNOT STAND ALONE BUT MUST BE USED IN CONJUNCTION WITH THE BASIC UNITIZATION PROCEDURES DRAWING 19-48-4116-20PA1002.

REVISIONS				REVISION NO.	DATE	BY	CHKD BY
1	NOV 81	WFE	WFE	1	NOV 81	WFE	WFE
2	NOV 82	WFE	WFE	2	NOV 82	WFE	WFE
3	DEC 83	WFE	WFE	3	DEC 83	WFE	WFE
				U.S. ARMY DARCOM DRAWING			
				JUNE 1981			
				CLASS	DIVISION	DRAWING	FILE
				19	48	4116/15C	20PA1002

SEAL FOR 1-1/4" STRAPPING (6 REQD, 1 PER STRAP). CRIMP EACH SEAL WITH TWO PAIR OF NOTCHES.

TIEDOWN STRAP, 1-1/4" X .035" OR .031" X 12'-8" LONG STEEL STRAPPING (4 REQD). SEE GENERAL NOTE "D" AT RIGHT.

LOAD STRAP, (ALTERNATE FOR HORIZONTAL STRAP), 1-1/4" X .035" OR .031" X 14'-2" LONG STEEL STRAPPING. THREAD LOAD STRAPS THRU PALLET STRAP SLOTS.

SUPPORT GATE (2 REQD). SEE DETAIL BELOW. STAPLE HORIZONTAL AND TIEDOWN STRAPS TO SUPPORT GATE AS SHOWN.

40" X 48" PALLET.

HORIZONTAL STRAP, 1-1/4" X .035" OR .031" X 16'-0" LONG STEEL STRAPPING (2 REQD). SEE GENERAL NOTE "C" AT RIGHT.

TYPICAL LOCATION FOR SECUREMENT OF A STRAP CUTTER. SEE GENERAL NOTE "F" AT RIGHT.

PALLET UNIT

SEE GENERAL NOTE "B" AT RIGHT.

24 BOXES OF 20MM CARTRIDGE (200 PER BOX) @ 160 LBS	3,840 LBS (APPROX)
DUNNAGE	61 LBS
PALLET	80 LBS
TOTAL WEIGHT	3,981 LBS (APPROX)
CUBE	40.0 CU FT (APPROX)

BILL OF MATERIAL

LUMBER	LINEAR FEET	BOARD FEET
1" X 4"	16.00	5.33
2" X 6"	19.00	19.00
NAILS	NO. REQD	POUNDS
6d (2")	48	0.28
PALLET, 40" X 48"	1 REQD	80 LBS
STEEL STRAPPING, 1-1/4"	82.67 REQD	11.81 LBS
SEAL FOR 1-1/4" STRAPPING	6 REQD	NIL
STAPLE	24 REQD	NIL

FILL PIECE, 1" X 4" X 8-1/4" (2 REQD). NAIL TO THE VERTICAL PIECE W/3-6d NAILS.

VERTICAL PIECE 2" X 6" X 14-1/2" (2 REQD).

HORIZONTAL PIECE, 2" X 4" X 18" (4 REQD). NAIL TO VERTICAL PIECES W/2-10d NAILS AT EACH JOINT.

FILLER ASSEMBLY
(FOR MINUS ONE BOX)

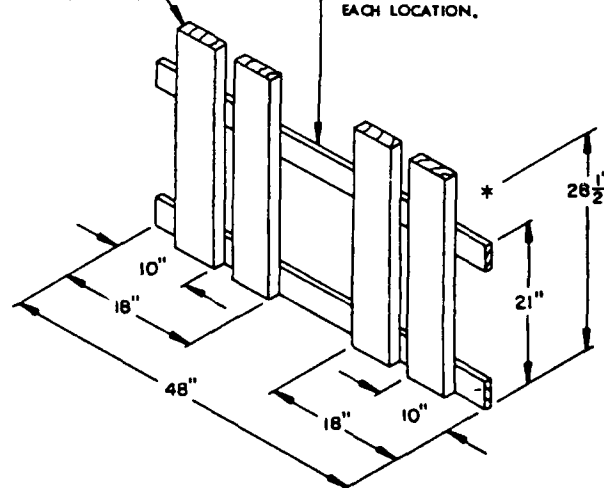
GENERAL NOTES

- THIS APPENDIX CANNOT STAND ALONE BUT MUST BE USED IN CONJUNCTION WITH THE BASIC UNITIZATION PROCEDURES DRAWING 19-48-4116-20PA1002. TO PRODUCE AN APPROVED UNIT LOAD, ALL PERTINENT PROCEDURES, SPECIFICATIONS AND CRITERIA SET FORTH WITHIN THE BASIC DRAWING WILL APPLY TO THE PROCEDURES DELINEATED IN THIS APPENDIX. ANY EXCEPTIONS TO THE BASIC PROCEDURES ARE SPECIFIED IN THIS APPENDIX.
- DIMENSIONS, CUBE AND WEIGHT OF A PALLET UNIT WILL VARY SLIGHTLY DEPENDING UPON THE ACTUAL DIMENSIONS OF THE BOXES AND THE WEIGHT OF THE SPECIFIC ITEM BEING UNITIZED.
- INSTALL EACH HORIZONTAL STRAP TO ENCLOSE EACH LAYER OF BOXES ON THE PALLET AND TO BE ALIGNED WITH THE HORIZONTAL PIECES OF THE "SUPPORT GATE" AS SHOWN. HORIZONTAL STRAPS MUST BE TENSIONED AND SEALED PRIOR TO APPLICATION OF TIEDOWN STRAPS.
- INSTALL EACH TIEDOWN STRAP TO PASS UNDER THE TOP DECK BOARDS OF THE PALLET AND TO BE ALIGNED WITH THE VERTICAL PIECES OF THE "SUPPORT GATE" AS SHOWN. TIEDOWN STRAPS WILL NOT BE APPLIED UNTIL THE HORIZONTAL STRAPS HAVE BEEN TENSIONED AND SEALED.
- THE FOLLOWING DARCOM DRAWINGS ARE APPLICABLE FOR OUTLOADING AND STORAGE OF THE ITEMS COVERED BY THIS APPENDIX.

CARLOADING	DRAWING 19-48-4115-SPA1002
TRUCKLOADING	DRAWING 19-48-4117-11PA1003
STORAGE	DRAWING 19-48-4118-1-2-3-4-14-22PA1002
- FOR METHOD OF SECURING A STRAP CUTTER TO THE PALLET UNIT, SEE DARCOM DRAWING 19-48-4127-20P1000.
- IF ITEMS COVERED HEREIN ARE UNITIZED PRIOR TO ISSUANCE OF THIS APPENDIX, THE BOXES NEED NOT BE REUNITIZED SOLELY TO CONFORM TO THIS APPENDIX.
- THE UNITIZATION PROCEDURES DEPICTED HEREIN MAY ALSO BE USED FOR UNITIZING 20MM CARTRIDGES WHEN IDENTIFIED BY DIFFERENT NATIONAL STOCK NUMBERS (NSN) THAN WHAT IS SHOWN ON THE TITLE PAGE, PROVIDED THE BOX PACK DOES NOT VARY FROM WHAT IS DELINEATED HEREIN. THE EXPLOSIVE CLASSIFICATION OF OTHER ITEMS MAY BE DIFFERENT THAN WHAT IS SHOWN.
- REGARDLESS OF THE QUANTITY OF BOXES TO BE PALLETIZED, THE TOTAL WEIGHT OF ANY PALLET UNIT WILL NOT EXCEED 4,000 POUNDS. WHEN THE TOTAL WEIGHT OF A FULLY LOADED PALLET UNIT EXCEEDS 4,000 POUNDS, ONE OR MORE LOADED BOXES MUST BE REMOVED, AND EITHER FILLER ASSEMBLIES, AS DEPICTED BELOW, OR EMPTY BOXES MUST BE SUBSTITUTED THEREFORE. FOR ADDITIONAL GUIDANCE, SEE THE "PROVISIONS FOR LESS-THAN-FULL-LAYER LOADS" ON PAGE 5 OF THE BASIC UNITIZATION PROCEDURES DRAWING 19-48-4116-20PA1002.

VERTICAL PIECE, 2" X 6" X 28-1/2" (4 REQD).

HORIZONTAL PIECE, 1" X 4" X 48" (2 REQD). NAIL TO VERTICAL PIECES W/3-6d NAILS AT EACH LOCATION.



SUPPORT GATE
(2 REQD).